SIEMENS

HICOR.NIU
(Network Interface Unit)

[redacted] AX

DICOM Conformance Statement

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Preface

The intent of any DICOM conformance statement is to provide a knowledgeable user with the information required to determine whether and to what extent independent DICOM implementations may be able to inter-operate. However, the information contained in a DICOM conformance statement is not sufficient to ensure independent implementations will, in fact, be able to inter-operate.

The user or system integrator must be aware of the following potential issues related to inter-operation:

- Using only the information provided by this Conformance Statement does not guarantee interoperability of the Siemens equipment described herein with other equipment. It is the user's (or system integrator's) responsibility to analyze thoroughly the application requirements and objectives to determine if they can be met by the connection of Siemens equipment to other equipment.

- Siemens equipment has been tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance statement. It is the responsibility of the user (or system integrator) to specify and carry out additional validation testing, which covers a broad spectrum of potential interactions between the independent implementations.

- Siemens reserves the right to make changes to its products or to discontinue their delivery. Therefore, the user (or system integrator) should ensure that any future versions of Siemens or other connected equipment are regression tested to verify that new software releases have not adversely impacted the ability to inter-operate.

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0 Introduction

This document provides the conformance statement for the HICOR Network Interface Unit (HICOR.NIU) product. Its purpose is to allow users of the NIU to determine which optional components of the DICOM Standard are supported, including Service Classes, SOP Classes, communication protocols, roles, optional (Type 3) Attributes, etc.

The HICOR.NIU provides a network interface between labs based on HICOR and a DICOM destination.

Siemens has tested and approved this connection with GEMnet and a general DICOM destination.

The HICOR addresses the NIU with the archive device configuration setting of "G1".

1 Implementation Model

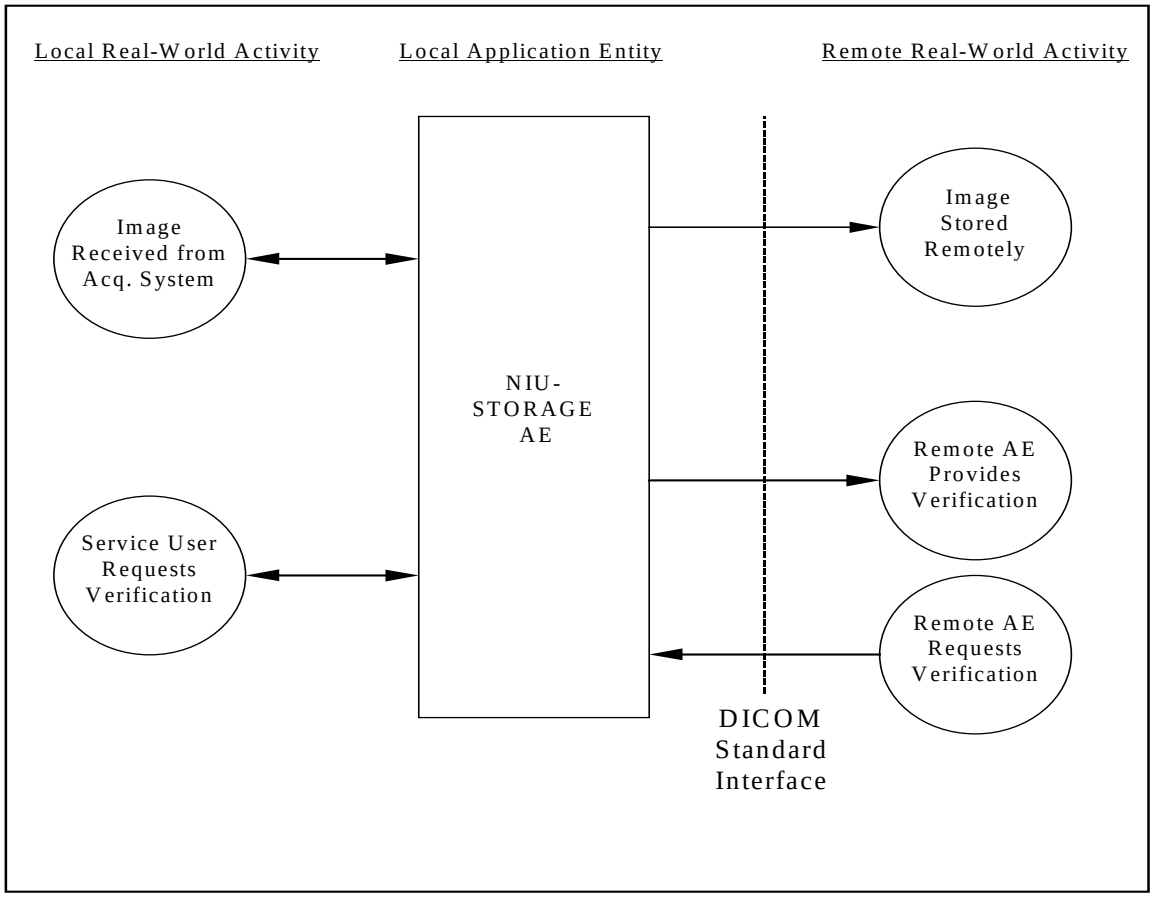
1.1 Application Data Flow Diagram

The NIU implementation consists of a single Application Entity called “NIU-STORAGE”. The NIU-STORAGE AE provides all of the DICOM services for the NIU.

The following Application Data Flow Diagram depicts the relationship of the AE’s use of DICOM to Real-World Activities. As documented in the PS3.2-1999 DICOM standard, the symbols used in this diagram have the following meanings:

- A double-headed arrow between a local real-world activity and the local application entity indicates a relationship between them (such as user interaction).
- An arrow from the local application entity to the remote real-world activity indicates that an occurrence of the local real-world activity will cause the local application entity to initiate an association for the purpose of causing the remote real-world activity to occur.
- An arrow from the remote real-world activity to the local application entity indicates that the local application entity expects to receive an association request when the remote real-world activity occurs, causing the local application entity to perform the local real-world activity.

Figure 1
Implementation Model



1.2 Functional Definition of Application Entities

The NIU-STORAGE AE provides all of the necessary functionality to implement network sending of the DICOM images. This includes, but is not limited to:

- association management
- image and demographics encoding
- image and demographics storage
- response interpretation
- communication readiness verification

1.3 Sequencing of Real-World Activities

Not Applicable.

2 Application Entity Specifications

The NIU is comprised of a single Application Entity, the NIU-STORAGE AE.

2.1 NIU-STORAGE Application Entity Specification

The NIU-STORAGE AE provides Standard Conformance to the following DICOM V3.0 SOP Classes as a Service Class User (SCU):

Table 1
Supported SOP Classes as SCU

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1

The NIU-STORAGE AE also provides Standard Conformance to the following DICOM V3.0 SOP Classes as a Service Class Provider (SCP):

Table 2
Supported SOP Classes as SCP

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

2.1.1 Association Establishment Policies

2.1.1.1 General

The NIU-STORAGE AE will always propose the DICOM Application Context Name (ACN), which is:

Application Context Name	1.2.840.10008.3.1.1.1

The maximum PDU lengths accepted by the NIU-STORAGE AE when acting as either an SCP or an SCU are configurable (refer to Section 5.2).

2.1.1.2 Number of Associations

The maximum number of simultaneous associations supported by the NIU-STORAGE AE, both proposed and accepted, is configurable. The maximum number of simultaneous associations proposed by the NIU-STORAGE AE is also configurable (refer to Section 5.2).

2.1.1.3 Asynchronous Nature

Multiple outstanding transactions are not supported by the NIU-STORAGE AE.

2.1.1.4 Implementation Identifying Information

The NIU-STORAGE AE will provide the following Implementation Identifying Information in the User Information Field of the A-ASSOCIATE request primitive during association establishment:

Table 3
Implementation Identifying Information

Implementation Class UID	1.2.840.113697.10.8
Implementation Version Name	"UDIG_v2.0.003" *

*The Implementation Version Name is formed by appending the software version to the end of the string "UDIG_v". This is an example corresponding to software version 2.0.003.

2.1.2 Association Initiation Policy

The NIU-STORAGE AE initiates associations for the following real-world activities:

- A service operator wants to verify communication with a Remote DICOM AE or, as part of NIU's normal operation, the NIU periodically wants to verify communication with the Image Destination Remote DICOM AE
- An image is received from an in-lab acquisition system for translation and transfer to the Image Destination Remote DICOM AE

2.1.2.1 Real-World Activity *"Verify Communication With Remote AE"*

2.1.2.1.1 Associated Real-World Activity

A service operator invokes a command from the NIU console using the UDIG Config configuration tool to verify communications with a Remote DICOM AE. The operator selects the Remote AE to be checked. The NIU-STORAGE AE will also perform Verification on a periodic basis, without any associated local Real-World Activity. This polling interval is configurable (refer to Section 5.2).

2.1.2.1.2 Proposed Presentation Contexts

The following table presents the Presentation Contexts, which are proposed by the NIU-STORAGE AE for Real-World Activity "*Verify Communication With Remote AE*". Presentation Contexts containing XA Image Storage are proposed in addition to Verification for the purpose of determining the communication readiness of SCPs that do not support the Verification SOP class. Such an SCP will accept only an XA PC item, which the NIU interprets as the SCP being "alive". The association is then released without performing any operation upon it.

Table 4
Presentation Context Table
for Real-World Activity
"Verify Communication With Remote AE"

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 11 [Selection Value 1])	1.2.840.10008.1.2.4.70	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

2.1.2.1.2.1 SOP Specific Conformance for Verification SOP Class

The NIU-STORAGE AE provides standard conformance to the Verification SOP class.

2.1.2.2 Real-World Activity *"Image Received from Acquisition System"*

2.1.2.2.1 Associated Real-World Activity

After an image is received from HICOR system, the NIU-STORAGE AE initiates a new association with a pre-configured Image Destination Remote DICOM AE on which the image is transferred for storage.

2.1.2.2.2 Proposed Presentation Contexts

The following table presents the Presentation Contexts, which are proposed by the NIU-STORAGE AE for Real-World Activity *"Image Received from Acquisition System"*.

Table 5
Presentation Context Table
for Real-World Activity
"Image Received from Acquisition System"

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])*	1.2.840.10008.1.2.4.70	SCU	None
		Explicit VR Little Endian*	1.2.840.10008.1.2.1	SCU	None
		Implicit VR Little Endian*	1.2.840.10008.1.2	SCU	None

* The JPEG14 and EVR-LE transfer syntaxes are only proposed when the Image Storage Format setting is JPEG14. The IVR-LE transfer syntax is not proposed for certain Image Destinations to preserve private element explicit VRs.
HICOR.NIU will use the "Implicit VR Little Endian" Transfer Syntax with GEMnet.

2.1.2.2.2.1 SOP Specific Conformance for XA Image Storage SOP Class

The SOP Specific Conformance for the X-Ray Angiographic Image Storage SOP Class is detailed here.

When a "Success" (0000) or "Warning" (Bxxx) response status to a C-STORE operation is received by the NIU-STORAGE AE, the transmission is assumed to be successful and the association is released. A "Success" status is then returned to the in-lab acquisition system. In the case of a "Warning" status, the exact status returned by the Remote AE is logged in the NIU event log.

When a "Refused" or "Error" response status to a C-STORE operation is received by the NIU-STORAGE AE, the association is released and an error status is returned to the HICOR system. The exact status returned by the Remote AE is logged in the NIU event log.

The tables listed in the Appendix give detailed information about the Attributes included when the NIU-STORAGE AE sends a HICOR XA SOP Instance.

2.1.3 Association Acceptance Policy

The NIU-STORAGE AE accepts associations for the following real-world activities:

- A Remote DICOM AE wants to verify communication with the NIU-STORAGE AE

2.1.3.1 Real-World Activity *"Verify Communication For Remote AE"*

2.1.3.1.1 Associated Real-World Activity

The NIU-STORAGE AE will respond automatically to Verification requests from Remote Aes to provide an SCU with verification that the NIU-STORAGE AE is able to receive DICOM requests. This is typically initiated by an operator at the Remote AE.

2.1.3.1.2 Presentation Context Table

The following table presents the Presentation Contexts, which are acceptable to the NIU-STORAGE AE for Real-World Activity *"Verify Communication For Remote AE"*:

Table 6
Presentation Context Table
for Real-World Activity
"Verify Communication For Remote AE"

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name**	**UID**		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

2.1.3.1.2.1 SOP Specific Conformance for Verification SOP Class

The NIU-STORAGE AE provides standard conformance to the Verification SOP class.

2.1.3.1.3 Presentation Context Acceptance Criterion

Not applicable.

2.1.3.1.4 Transfer Syntax Selection Policies

Not applicable.

3 Communication Profiles

The NIU provides only DICOM V3.0 TCP/IP Network Communication Support as specified in PS3.8 (DICOM Part 8). Neither the OSI nor point-to-point stacks are supported with this implementation.

3.1 TCP/IP Stack

The TCP/IP stack used by this implementation is inherited from the Microsoft Windows NT operating system on which it executes.

3.1.1 API

Not applicable.

3.1.2 Physical Media Support

The NIU provides support for DICOM Network Communication on the following physical media:

- IEEE 802.3u-1995 (Fast Ethernet) on Twisted Pair cable (100BASE-TX)

4 Extensions/Specializations/Privatizations

4.1 Standard Extended/Specialized/Private SOPs

Please see Appendix for details on the Standard Extended SOP Class sent by HICOR.NIU.

4.2 Private Transfer Syntaxes

Not applicable.

5 Configuration

The NIU maintains configuration data in the Windows NT Registry, which is saved on local disk storage. A service person may configure the NIU using the local UDIG Config and standard Windows NT configuration tools.

5.1 AE Title/Presentation Address Mapping

The default AE Title of the NIU-STORAGE AE is “UDIG100_1” and is configurable. The IP address and TCP Listen port of the NIU are also configurable.

The AE Title, IP address and TCP Listen port for the Remote DICOM AE are configurable on the NIU.

The mapping of AE Titles to TCP/IP addresses and ports is kept in a Host Registry, which is maintained in the Windows NT Registry, and can be edited using the UDIG Config configuration tool.

5.2 Configurable Parameters

- Image Source (HICOR), configured via license file
- Image Destination ("GE ARM" (GEMnet), "Generic DICOM", "Camtronics Vericis Server", "Inturis Suite"), configured via Config tool
- Time-outs: Association (ARTIM) Timer (default = 30 seconds), Command Read Timer (default = 600 seconds), Command Write Timer (default = 30 seconds), Data

Read Timer (default = 30 seconds), Data Write Timer (default = 30 seconds), Open Connection Timer (default = 20 seconds), Close Connection Timer (default = 20 seconds).

- Maximum PDU Length: SCP (default = 128 Kbytes), SCU (default = 128 Kbytes)
- Number of simultaneous associations supported (both accepted and proposed) (default = 20)
- Number of simultaneous associations proposed / C-STORE transfers (default = 2 for "GE ARM" and "Camtronics Vericis Server" else default = 1, range = 1 – 9)
- Image Destination C-ECHO Polling Interval in seconds (default = 60, range = 10 – 300)
- Duplicate SOP Instance C-STORE Status code of Image Destination (default = $C111_{hex}$ for GEMnet, else default is $FFFFFFFF_{hex}$ [none])
- Number of C-STORE retries that will be made to overcome transient communication errors with the Image Destination (default = -1 [infinite])
- Image Storage Format: The transfer syntax used when HICOR.NIU encodes a DICOM image (default is LE-IVR for GEMnet and JPEG14 for all other destinations). Note that the storage format at the server will depend further upon association negotiation.

6 Support of Extended Character Sets

This implementation supports the following extended character set:

- ISO-IR 100 (as defined in ISO 8859, Part 1 – Latin alphabet No. 1)

7 Appendix: Supported Attributes

Notes:

- Value noted within < > refers to the default value used.
- String values are noted via quotation marks (e.g. “MONOCHROME2”).
- <EMPTY> defines type 2 DICOM elements have zero length, while type 3 elements are not included.
- The **@** symbol in DICOM element column of Mapping Table specifies private element.
- The private elements describing Edge Enhancement attributes (see elements 0029,xxxx) will always exist, regardless of destination.
- Character strings will be converted into Latin 1 characters, if required, via a Config setting on NIU.
- The physician_name and patient_name data strings from the HICOR are used for tags (0008,1050) - Performing Physician's Name, and (0010,0010) - Patient's Name, respectively. These data strings originating from the HICOR for the corresponding DICOM tags are to be in the DICOM PN (Person Name) format. Thus, these strings are not parsed in any manner by the UDIG.

X-RAY ANGIOGRAPHIC IMAGE

DICOM tag	Name	Value
(0008, 0005)	specific character set	<“ISO_IR 100”>
(0008, 0008)	image type	“ORIGINAL\PRIMARY\BIPLANE A” “ORIGINAL\PRIMARY\BIPLANE B” “ORIGINAL\PRIMARY\SINGLE PLANE\SINGLE A” “ORIGINAL\PRIMARY\SINGLE PLANE\SINGLE B”
(0008, 0014)	instance creator UID	“1.2.840.113697.10.3.{*UDIG S/N*}”
(0008, 0016)	SOP class UID	“1.2.840.10008.5.1.4.1.1.12.1”
(0008, 0018)	SOP instance UID	{***dbms_uid[]***}
(0008, 0020)	study date	{***date_created***}
(0008, 0023)	image date	{***dbms_date_created***}
(0008, 0030)	study time	{***time_created***}
(0008,0033)	image time	{***dbms_time_created***}
(0008, 0050)	accession number	{***dicom_accession_nr***} or <EMPTY>
(0008, 0060)	modality	<“XA”>
(0008, 0070)	manufacturer	<“SIEMENS”>
(0008, 0080)	institution name	{***institution_name***} or {*via registry setting*}
(0008, 0081)	institution address	{*via registry setting*} or <EMPTY>
(0008, 0090)	referring physician’s name	<EMPTY> Not Available
(0008, 1010)	station name	{*via registry setting*} or <EMPTY>
(0008, 1030)	study description	{***summary***} or <EMPTY>
(0008, 1050)	performing physician’s name	{***physician_name***} or <EMPTY>
(0008, 1090)	manufacturer’s model name	<”HICOR-UDIG”>
(0008, 1140)	referenced image sequence	Only if 3rd value of 0008,0008 indicates BIPLANE A/B
(0008, 1150)	>referenced SOP class UID	“1.2.840.10008.5.1.4.1.1.12.1”
(0008, 1155)	>referenced SOP instance UID	Correlated plane from {***dbms_uid[]***}
(0010, 0010)	patient’s name	{***patient_name***} or <EMPTY>
(0010, 0020)	patient id	{***patient_id***} or “{***date_created***}_{***time_created***}”
(0010, 0030)	patient’s birth date	{***birthday***} or <EMPTY>
(0010, 0040)	patient’s sex	{***sex***} or <EMPTY>
(0010, 1020)	patient’s size	{***height***} or <EMPTY>
(0010, 1030)	patient’s weight	{***weight***} or <EMPTY>
(0018, 0010)	contrast/bolus agent	<EMPTY> Not Available

DICOM tag	Name	Value
(0018, 0060)	KVP	<EMPTY> Not Available
(0018, 1063)	frame time	Derived from HICOR and 'AC Line Frequency' registry setting
(0018, 1152)	Exposure	<EMPTY> Not Available
(0018, 1155)	radiation setting	<"GR">
(0018, 1500)	positioner motion	"STATIC" or <EMPTY>
(0018, 1510)	positioner primary angle	Derived from HICOR or <EMPTY>
(0018, 1511)	positioner secondary angle	Derived from HICOR or <EMPTY>
(0020, 000D)	study instance UID	{***study_uid***}
(0020, 000E)	series instance UID	{***series_uid***}
(0020, 0010)	study id	{***dicom_study_id***} or <"*{**date_created**}_{**time_created**}*">
(0020, 0011)	series number	<1>
(0020, 0012)	acquisition number	{***dbms_scene_num***}
(0020, 0013)	instance number	{***dbms_scene_num***}
(0020, 0020)	patient orientation	<EMPTY>
(0020,4000)	image comments	"Hicor Cont." or "Hicor DPF" or "Hicor Cine" or "Hicor DCM" or "Hicor Angio"
(0028, 0002)	samples per pixel	<1>
(0028, 0004)	photometric interpretation	<"MONOCHROME2">
(0028, 0008)	number of frames	Derived from HICOR
(0028, 0009)	frame increment pointer	<0018,1063>
(0028, 0010)	rows	<512>
(0028, 0011)	columns	<512>
(0028, 0034)	pixel aspect ratio	<EMPTY>
(0028, 0100)	bits allocated	<8>
(0028, 0101)	bits stored	<8>
(0028, 0102)	high bit	<7>
(0028, 0103)	pixel representation	<0>
(0028, 1040)	pixel intensity relationship	"LOG" or "LIN"
(0028, 1050)	window center	Derived from HICOR
(0028, 1051)	window width	Derived from HICOR
(0028, 1090)	recommended viewing mode	"SUB" or <EMPTY>
(0028,3000)	Modality LUT Sequence	Only if DICOM element (0028, 1040) is "LOG"
(0028,3002)	>LUT Descriptor	<256, 0, 8>
(0028,3004)	>modality LUT Type	<"US">
(0028,3006)	>LUT Data	<256 LUT data values>
(0028, 6010)	representative frame number	<value of DICOM element (0028,0008) / 3 + 1>
(0028, 6100)	mask subtraction sequence	Only if DICOM element (0028, 1090) is "SUB"
(0028, 6101)	>mask operation	<"AVG_SUB">
(0028, 6110)	>mask frame numbers	{***rply_mask_frame***}+1
(0029,0010) **@**	Private Creator	<"CARDIO-D.R. 1.0">
(0029,1003) **@**	Edge Enhancement Gain	0 or <gain based on registry setting>
(7FE0, 0010)	pixel data	